CLAIMS

1. Apparatus for suppressing interference in a received electronic communications signal, comprising:

an adaptive filter configured to remove components from said received communications signal, said adaptive filter being operable in a first adaptive mode to adapt to changes in said received communications signal, and in a second mode having an at least reduced adaptability compared to said first mode; and

a control circuit configured to control the mode of said adaptive filter in dependence on whether said received communications signal contains a signal of interest.

2. The apparatus according to claim 1, wherein said second mode of said adaptive filter is a non-adaptive mode, in which filter taps do not adapt to changes in said received communications signal.

3. The apparatus according to claim 1, wherein said control circuit is configured to set said operating mode of said filter to said second mode when said received communications signal contains said signal of interest.

4. The apparatus according to claim 1, wherein said control circuit is configured to set said operating mode of said filter to said first adaptive mode in the absence of said signal of interest in said received communications signal.

5. The apparatus according to claim 1, wherein said adaptive filter comprises a Wiener filter.

6. The apparatus according to claim 1, wherein said adaptive filter receives said communications signal as a first input, and a delayed communications signal as a second reference input.

7. The apparatus according to claim 1, wherein said adaptive filter comprises at least one finite impulse response filter.

8. The apparatus according to claim 7, wherein said adaptive filter comprises first and second finite impulse response filters coupled in a series-parallel arrangement.

9. The apparatus according to claim 1, wherein said control circuit comprises a detector configured to detect the presence of said signal of interest in said received communications signal.

10. The apparatus according to claim 9, wherein said detector has a response time less than an adaptation time of said adaptive filter when in said first adaptive mode.

11. The apparatus according to claim 9, wherein said detector is downstream of said adaptive filter, and is configured to detect the presence of said signal of interest in said received communications signal after filtering by said adaptive filter.

12. The apparatus according to claim 9, wherein said detector comprises:

a first detection section configured to detect the presence of a coherent component in said received communications signal; and

a second classification section configured to classify whether said detected coherent component is said signal of interest.

13. The apparatus according to claim 12, wherein said control circuit is configured, responsive to detection of said coherent component by said first detection section, to:

(i) generate a control signal to set said adaptive filter to said second mode;

(ii) generate a control signal to keep said adaptive filter in said second mode if said coherent component is classified as being said signal of interest; and

(iii) generate a control signal to set said adaptive filter to said first adaptive mode if said coherent component is classified as not being said signal of interest.

14. The apparatus according to claim 12, wherein said second classification section is configured to detect the presence of at least one characteristic indicative of frequency shift keying.

15. The apparatus according to claim 1, further comprising a frequency converter configured to convert said received electronic communications signal to a complex baseband signal in which a first FSK component is represented as a first complex signal and a second FSK component is represented as a second complex signal.

16. The apparatus according to claim 15, wherein said frequency converter is upstream of said adaptive filter.

17. The apparatus according to claim 15, further comprising a discriminator for discriminating between said first and second complex signals, and for generating a signal for distinguishing a change of FSK frequency component.

18. The apparatus according to claim 17, wherein said discriminator is downstream of said adaptive filter.

19. The apparatus according to claim 17, further comprising an autocorrelator configured to estimate a characteristic of said complex signal in said complex baseband.

20. The apparatus according to claim 19, wherein the autocorrelator is configured to applying a weighted average to the result of the autocorrelation, and to normalize said autocorrelation.

21. The apparatus according to claim 17, wherein the discriminator is responsive to a directional characteristic of a vector representing said complex signal in complex space.

22. The apparatus according to claim 21, wherein said directional characteristic is a quantized angle of said vector.

23. The apparatus according to claim 22, wherein said quantization is based on a quantization unit of 360 degrees divided by N, where N is an integer greater than 1.

24. The apparatus according to claim 23, wherein said quantization unit is 180 degrees.

25. The apparatus according to claim 23, wherein said quantization unit corresponds to a sign of an imaginary part of said vector.

26. The apparatus according to claim 17, wherein said discrimination is performed using a sign of an imaginary part of said complex signal.

27. The apparatus according to claim 23, wherein said quantization unit is 90 degrees.

28. The apparatus according to claim 27, wherein said quantization unit corresponds to signs of real and imaginary parts of said vector.

29. The apparatus according to claim 22, wherein said quantization unit is less than 90 degrees.

30. The apparatus according to claim 29, wherein said discriminator is configured to assign one of a plurality of N predetermined index values to said directional characteristic of said complex signal, to quantize said directional characteristic of said signal.

31. The apparatus according to claim 30, wherein the discriminator is configured to:

(a) determine whether real and imaginary parts of said complex signal are both positive and, if not, then to apply a transform to said complex signal into a quadrant of complex space in which said real and imaginary parts are both positive; and

(b) assign an index value with respect to said positive real and imaginary parts of said complex signal.

32. The apparatus according to claim 30, wherein the discriminator is configured to detect an occurrence of a change in index value greater than a predetermined threshold difference magnitude.

33. The apparatus according to claim 32, wherein the discriminator is configured to identify a change in index value between a first stable value and a second stable value.

34. The apparatus according to claim 1, implemented as a digital circuit for processing samples of said received communications signal.

35. The apparatus according to claim 1, implemented within a communications signal receiver.

36. The apparatus according to claim 1, implemented within a receiver of a remote control system.

37. A method of suppressing interference in a received communications signal, said method comprising:

filtering said received communications signal to remove components therefrom using an adaptive filter controllable in a first adaptive mode in which adaptive filter taps adapt to changes in the received communications signal, and a second mode having an at least reduced adaptability compared to said first mode; and

controlling said mode of said adaptive filter in dependence on whether said received communications signal contains a signal of interest.

38. The method according to claim 37, wherein said second mode of said filter is a non-adaptive mode in which said filter taps do not adapt to changes in said received communications signal.

39. The method according to claim 37, wherein the step of controlling comprises selecting said first mode when no signal of interest is detected in said received communications signal.

40. The method according to claim 37, wherein the step of controlling comprises selecting said second mode when said signal of interest is detected in said received communication signal.

41. The method according to claim 37, wherein the step of controlling comprises detecting a presence of said signal of interest in said received communications signal after the step of filtering.

42. The method according to claim 37, further comprising adding an artificial interference component to said received communications signal, to influence filter coefficients of said adaptive filter in the absence of external interference.

43. The method according to claim 37, wherein said signal of interest is a frequency shift keyed signal.

44. The method according to claim 43, further comprising a step of converting said received communications signal to a complex baseband in which a first FSK component frequency is represented as a first complex signal, and a second FSK component frequency is represented as a second complex signal.

45. The method according to claim 44, further comprising a step of discriminating between the first FSK component and the second FSK component using a directional characteristic of a vector representing said complex signal in complex space.

46. The method according to claim 45, wherein said directional characteristic is a quantized angle of said vector.

47. The method according to claim 46, wherein said quantization is based on a quantization unit of 360 degrees divided by N, where N is an integer greater than 1.

48. The method according to claim 47, wherein the step of discriminating comprises detecting a change in said quantized angle of said vector.

49. The method according to claim 48, wherein said change is compared to a threshold greater than 2 to determine whether or not said change is a candidate to represent a change in FSK component frequency.

50. A method of controlling an adaptive filter for suppressing interference in a received communications signal, the method comprising:

detecting whether or not a signal of interest is present in said received communications signal;

controlling said filter to be in a first adaptive mode for adaptively filtering components from said received communications signal, if no signal of interest is detected; and

controlling said filter to be in a second mode having an at least reduced adaptability compared to the first mode, if said signal of interest is detected.

51. The method according to claim 50, wherein said second mode is a non-adaptive mode in which filter taps do not adapt to changes in said received communications signal.

52. The method according to claim 50, further comprising adding an artificial interference component to said received communication signal, to influence filter coefficients of said adaptive filter in the absence of external interference.

53. Apparatus for processing a received modulated communications signal, comprising:

a frequency converter configured to convert said received communications signal to a complex baseband signal;

an adaptive filter configured to adaptively remove coherent interference from said complex baseband signal; and

a signal processor configured to process the filtered complex baseband signal to recognize a signal of interest, and to demodulate a message therefrom.

54. The apparatus according to claim 53, wherein said signal processor is responsive to said signal of interest to control a characteristic of said adaptive filter.

55. The apparatus according to claim 53, wherein the signal processor comprises an autocorrelator for estimating a characteristic of said complex baseband signal.

56. The apparatus according to claim 55, wherein said characteristic is a directional characteristic of a vector representing said complex baseband signal in complex space.

57. The apparatus according to claim 55, wherein said signal processor comprises a demodulator configured to demodulate said complex baseband signal based on said estimated characteristic.

58. The apparatus according to claim 55, wherein said signal processor comprises a detector configured to detect a presence of said signal of interest in said complex baseband signal based on said estimated characteristic.

59. A method of processing a received modulated communications signal, comprising:

converting said received communications signal to a complex baseband signal;

adaptively filtering said complex baseband signal to remove coherent interference therefrom; and

processing said filtered complex baseband signal to recognize a signal of interest, and to demodulate a message therefrom.

60. The method according to claim 59, wherein the step of processing comprises controlling a characteristic of said adaptive filter in response to detection of a signal of interest in said complex baseband signal.

61. The method according to claim 59, wherein the step of processing comprises using autocorrelation to estimate a characteristic of said complex baseband signal.

62. The method according to claim 61, wherein said characteristic is a directional characteristic of a vector representing said complex baseband signal in complex space.

63. The method according to claim 61, wherein the step of processing comprises demodulating said complex baseband signal based on said estimated characteristic.

64. The method according to claim 61, wherein the step of processing comprises detecting a presence of a signal of interest in said complex baseband signal based on said estimated characteristic.

65. Apparatus for processing frequency shift keyed (FSK) components of a received communications signal, the apparatus comprising:

a frequency converter configured to convert the received electronic communications signal to a complex baseband signal in which a first FSK component is represented as a first complex signal and a second FSK component is represented as a second complex signal; and

a discriminator configured to discriminating between said first and second complex signals, and to generate a signal for distinguishing a change of FSK frequency component.

66. The apparatus according to claim 65, wherein said discriminator is responsive to a directional characteristic of a vector representing said complex signal in complex space.

67. The apparatus according to claim 66, wherein said directional characteristic is a quantized angle of said vector.

68. The apparatus according to claim 67, wherein said quantization is based on a quantization unit of 360 degrees divided by N, where N is an integer greater than 1.

69. The apparatus according to claim 68, wherein said quantization unit is 180 degrees.

70. The apparatus according to claim 69, wherein said quantization unit corresponds to a sign of an imaginary part of said vector.

71. The apparatus according to claim 65, wherein said discriminator is configured to perform said discrimination using a sign of an imaginary part of said complex signal.

72. The apparatus according to claim 68, wherein said quantization unit is 90 degrees.

73. The apparatus according to claim 72, wherein said quantization unit corresponds to signs of real and imaginary parts of said vector.

74. The apparatus according to claim 67, wherein said quantization unit is less than 90 degrees.

75. The apparatus according to claim 68, wherein said discriminator is configured to assign one of a plurality of N predetermined index values to said directional characteristic of said complex signal, to quantize said directional characteristic of said signal.

76. The apparatus according to claim 65, wherein said discriminator comprises an autocorrelator configured to estimate said directional characteristic of said vector representing said complex signal.

77. A method of processing frequency shift keyed (FSK) components of a received communications signal, the method comprising:

converting said received electronic communications signal to a complex baseband signal in which a first FSK component is represented as a first complex signal and a second FSK component is represented as a second complex signal; and

discriminating between said first and second complex signals, and generating a signal for distinguishing a change of FSK frequency component.

78. The method according to claim 77, wherein the step of discriminating comprises processing a directional characteristic of a vector representing said complex signal in complex space.

79. The method according to claim 78, wherein said directional characteristic is a quantized angle of said vector.

80. The method according to claim 79, wherein said quantization is based on a quantization unit of 360 degrees divided by N, where N is an integer greater than 1.